

The farm forest resource in Ireland: opportunities and challenges for rural development in Ireland

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Abstract A critical mass of farm forestry and private forestry is now developing in Ireland with over 211,000 ha planted since 1980, with 190,000 ha of this planted since 1990. Currently, 90,000 ha of private forests are over 10 years of age, with 41,000 ha over 15 years of age. This paper examines the potential of the farm forest resource in Ireland and highlights some issues that need to be addressed in order that the full potential of farm forestry is realised. It is estimated that 876,000 m³ of timber is currently available from forests through removals from thinning operations from plantations that are at or have passed first thinning age. Cumulative volume output from thinning could be as high as 1.9 M m³ by 2010 increasing to 5.9 M m³ by 2015. Farm forestry has the potential to be a financially important farm enterprise with 15% of farmers (16,460) currently engaged in forestry in Ireland. The development of volume production forecasts will provide crucial supply information for gearing up of the wood-processing sector for additional volume from farms. However many enterprises face high harvesting and extraction costs. Solutions to overcoming economies of scale due to the small size of plantations (averaging 9.2 ha) are proposed using methods to group forestry operations together. The network of small sawmills throughout the country is favourable for private growers as analysis indicates that 82% of private forests are within 32 km of a sawmill and efforts to stimulate local processing are being encouraged. Financial analysis indicates that farmers can increase forestry returns by thinning their plantations. The risk of windthrow to plantations is one of the major factors that can lead to financial losses in farm forestry in Ireland and can be reduced by adequate management planning. A series of forestry extension programs will provide farmers with adequate information to help aid decision-making in managing their plantations.

Keywords Grant aided forests · Thinning and harvesting · Production forecast · Economic potential · Rural development

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Introduction

Small amounts of private forestry planting took place in Ireland—mostly on large estates—from when grants were introduced in 1931. The rate increased sharply from 1980 onwards as a result of increases in EU and government funding. Since 1980, 211,357 ha of forest have been planted (Forest Service 2005). The majority of this afforestation has received grant assistance from EU and the Irish government under a variety of schemes, including the Western Package, the Compensatory Allowance and the Forestry Grant and Premium Schemes. Planting reached a peak of almost 17,500 ha in 1995; today the average annual planting rate is about 12,000 ha. The age distribution of these forests indicates that a high proportion of the area is rapidly approaching or has passed first thinning age. Over 41,000 ha or 20% of these forests have now passed 15 years of age (Fig. 1).

Forest Ownership

There are 19,616 private forest owners in Ireland (Forest Service 2005). Of these, 16,460 (84%) are classed as farmers. The definition of farmer in this context is a person who derives 25% or more of their annual incomes from agricultural enterprises. The remainder of forests owners (3216) are classed as private landowners and investors (both individuals or companies). The ownership of the resource by area planted is broadly similar with 83% of the forest area (149,078 ha) owned by farmers. A further division of farmers into ‘full time’ and ‘part time’ is based on whether farmers are actively engaged in farming practice and whether farming provides the sole source of income or if farming provides only part of their income. Many part-time farmers in Ireland support their income from off-farm jobs in the construction, service and manufacturing industries. For grant payment purposes, however, there is no difference between part-time or full-time farmers. Full details are provided in Table 1.

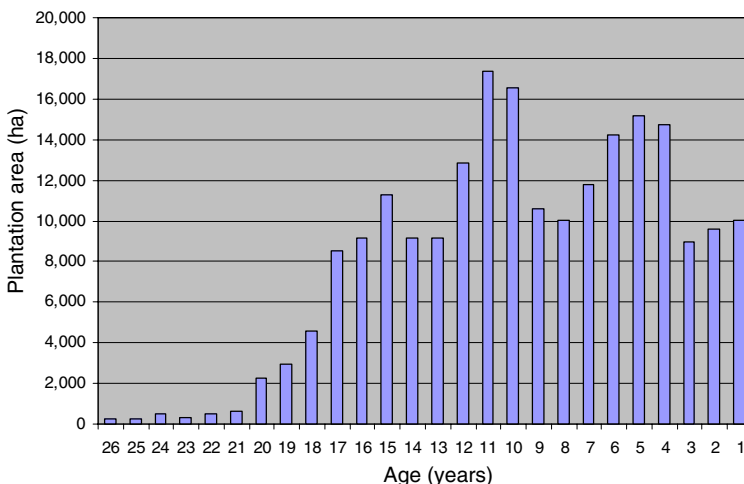


Fig. 1 The age profile of private forest plantations in Ireland (planted since 1980)

Table 1 Numbers of full-time and part-time farmers and non-farmers, area planted and average plantation size, Ireland, 1990–2004

Full-time farmers			Part-time farmers			Non-farmers			Total		
No	Area (ha)	Av. area (ha)	No.	Area (ha)	Av. area (ha)	No.	Area (ha)	Av. area (ha)	No.	Area (ha)	Av. area (ha)
12995	117,327	9.0	3465	31,751	9.2	3216	31,464	9.8	19676	180,542	9.2

Forecast Production and Monetary Value

Recent scenario modelling undertaken in Teagasc in Athenry, Co., Galway, suggests that if 50% of these plantations (41,224 ha) were suitable for thinning, then an estimated 876,000 m³ of timber would be currently available from these forests through removals from thinning operations. Many of these plantations are overdue for thinning or need to be thinned urgently. A forecast of timber production indicates that the cumulative volume output from thinning will be 1.9 M m³ by 2010 increasing to 5.9 M m³ by 2015.¹ If all the areas greater than 15 years of age, suitable for thinning, were thinned in the period 2007–2015, then the annual production from first thinning could potentially rise from 194,000 m³ in 2007 to a potential 368,589 m³ by 2010 and 302,000 m³ by 2013 (Table 2). When combined with outputs from a

Table 2 The potential output from thinning from private forests based on 50% of stands being thinned over the period 2006–2015

First thinning year	Area (ha)	Prod area (ha) ^a	First thinning volume (m ³) ^b	Second thinning year	Prod. area (ha)	Second thinning volume (m ³) ^c	Cumulative volume output (m ³)
2006	41,224	17,520	876,010 ^d				876,010
2007	9,134	3,882	194,098				1,070,108
2008	9,171	3,898	194,884				1,264,991
2009	12,837	5,456	272,786				1,537,778
2010	17,343	7,371	368,539				1,906,316
2011	16,555	7,036	351,794	2011	17,520	1,226,414 ^e	3,484,524
2012	10,583	4,498	224,889	2012	3,882	271,737	3,981,149
2013	10,002	4,251	212,543	2013	3,898	272,837	4,466,529
2014	11,777	5,005	250,261	2014	5,456	381,901	5,098,691
2015	14,231	6,048	302,409	2015	7,371	515,954	5,917,054
Total	152,857	64,964	3,248,211	10,065	38,126	2,668,843	

^a Productive area is classed as 85% of 50% of the area figure in column 2

^b First thinning volume is based on removing 50 m³/ha at 15 years of age

^c Second thinning volume is based on removing 70 m³/ha at 20 years of age

^d The analysis assumes that the average volume removed in first thinning is 50 m³/ha on a total productive area of 17,500 ha

^e The analysis assumes that areas that received a first thinning receive a second thinning after five years where the average volume removed in second thinning is 70 m³/ha on a total productive area of 17,500 ha

¹ These figures are based on first thinnings from the period 2006–2010 and include first and second thinnings over the period 2006–2015.

second thinning the average output from thinning could reach an estimated 500,000 m³ over the period 2012–2015.

Translated to monetary terms the value of such a first thinning operation is equivalent to a €16 M injection into the local economy in standing timber sales over the period 2006–2015.² The value of second thinning is estimated to be €40 M over the same period.³ A total injection of €56 M directly into grower's pockets will make private and farm forestry a financially important farm enterprise if the potential is realised. The resulting downstream value of processed forest material from thinnings from farm forests on the open market is considerably more.⁴

This coupled with the stimulation of rural employment and the associated economic benefits of the resource to the local economy indicates the potential that this small-scale forestry resource has to the rural economy in Ireland.

Key Issues to Address for Farm Forestry in Ireland

In order that the full potential of the afforestation program in Ireland is realised, there are many obstacles that need to be overcome, including:

1. Finding new markets for produce
2. Economies of scale and size of forests
3. High cost of harvesting
4. Location/distance of forest from potential markets
5. Inadequate forest road access to plantations
6. Susceptibility of farm plantations to wind damage
7. Timing of operations and financial consequences
8. Lack of forestry knowledge among farmers and willingness and ability to conduct operations
9. Promotion of good practice in thinning and harvesting

New markets for plantation produce

The key requirements and issues for private growers to access new markets are:

- the development of a management inventory with forecasting potential at a local level.
- gearing up of the sawmilling sector to accommodate additional roundwood
- encouragement of small sawmillers into the marketplace
- capacity of the existing markets for additional output, and
- development of new wood markets (the wood energy market shows high potential).

It is urgent that forest owners identify potential markets for their thinnings. For various reasons (discussed below), most plantations in Ireland are currently unthinned. However there is no doubt that if markets were readily available and

² Based on an expected standing sale of first thinnings of €5 per m³.

³ Based on an expected standing sale of second thinnings of €15 per m³.

⁴ Additional value arises from processed wood products, such as stake wood, sawlog and wood chips.

the demand for produce was high then these forests would be thinned. Currently, most of the demand for roundwood is satisfied by Coillte, the state forestry company. If processing facilities including sawmills and board mills are to handle this extra volume of roundwood from private forests then it is clear that they need a mechanism through which to be informed about the additional volume expectations (production forecasts) from the private sector. This would allow processors to build extra capacity in their facilities to handle such additional production. This extra capacity would in turn provide the market necessary for roundwood from the private sector. The development of a management inventory of the private sector with forecasting potential at a local level would facilitate the provision of resource information about the timber supply to various interested parties and provide details about forthcoming timber expectations from the private sector.

Information from such a management inventory of private plantations would be used to stimulate the sawmilling and wood-processing sector. It would provide the crucial information necessary about supply that can be used to fill existing demand or in the development of new markets.

Many small sawmillers exist in Ireland who could play a key role in the development of markets for farm-grown timber. However, they need to be encouraged to purchase from the private forestry sector if they are to play a key role. This role may be in the purchasing of small timber lots from local growers to satisfy local markets.

It is probable that all the products from private forests may not be fully utilised even if the capacity to handle more roundwood was addressed. It is expected that 30% of the thinning produce would be suitable for pulp; this indicates that 1.7 M m³ will be available as pulpwood over the 2006–2015 time period. Although recent evidence indicates that the demand for timber from both sawmills and board mills is strong in Ireland and currently timber is being imported annually to satisfy this demand, the main obstacle to timber sale is cost of haulage from isolated plantations to mills. A recent study in County Clare indicated that in order to sell pulpwood, the distance from plantation to processing plant should be no greater than 30 miles (50 km) to make log transport economically justifiable (Co. Clare Rural Resource Development 2004). Information about the location of forests together with growth information would indicate which forests ready for thinning are located near to processing facilities, but further research is needed to develop a cost-effective method of extraction and transportation of timber from greater distances.

It is crucial that alternative markets for farm forest products are found in order to maximise the contribution of private forests to social and economic development in rural Ireland. One such market that is currently showing growing potential is the wood energy market. In areas where markets are difficult to find or the resource is close to urban centres, the wood energy market may provide other opportunities. Farmers may sell their logs to local heating facilities or utilise logs for their own heating requirements. There have been recent initiatives to investigate the market potential from farm forests in order develop a wood chip supply chain for wood energy in Ireland for small-scale commercial and residential use (O' Donovan 2006) and for large-scale industrial use (Walker 2006).

Although sawmills and boardmills have excess capacity in Ireland to cater for additional roundwood production, there may be sufficient additional volume to justify additional wood processing facilities, such as the setting up combined heat and power plants using forest residue. This would increase the market potential of

forest products. A detailed management inventory with production forecasts would help address these supply issues.

Economies of Scale and Size of Forest Properties

The key issues for private growers and economies of scale are:

- the development of methods to group forestry operations together, and
- the development of methods to market forest products from many farms combined into one sale lot based on clustering of private forests together.

The average size of holding (9.2 ha) is an important consideration in terms of the management of private forests in Ireland. These plantations are classed as small scale because they are characterised by the size of forest operations and this small size requires an adjustment of the professional forest management as applied in large forest estates (Wiersum et al. 2005). The adjustment in management is needed so that the forests areas are large enough to achieve economies of scale in logging and extraction of timber. Large plantations are easier to market to prospective buyers and forestry contractors because they provide large volumes of timber from one location. This creates weeks of continuous employment, and facilitates the planning of logistics for log extraction and transport to the mill. Smaller plantations are less attractive to prospective contractors or buyers because they provide small volumes of timber, through relatively short operating periods at any one location. In some cases, the cost of transportation of forest machinery may be prohibitively high and not justify harvesting such smaller areas. As a result, there is a danger that the smaller plantations will be more difficult to market and sell.

The average plantation size in the private forest estate in Ireland is 9.2 ha, with the average size of farmer-owned plantations at 9.1 ha and non-farmer plantations slightly larger at 9.8 ha (Forest Service 2005). In terms of carrying out first thinning from these plantations the average volume to be removed is of the order of 400 m³. Some areas may prove uneconomic because the costs may exceed the timber revenues generated. This is particularly a problem for smaller plantations and plantations that are located in remote areas, as profits from timber sales are eroded by harvest, extraction and haulage costs. The development of methods to group forestry operations together may help to reduce the costs associated with harvesting operations (Farrelly 2006). New research into these methods is expected to begin in 2007. The key objectives of the research include:

- the development of methods to quantify the forest resource and produce a timber forecast at a local level.
- the development of cluster groups where forestry operations can be performed together to minimize cost
- the development of cluster groups to market forest products from many farms combined into one sale lot rather than individual sales
- scheduling of harvesting to coincide with adjacent harvesting in similar locations based on demand for certain products

This research seeks to address the need for information about the forest resource by developing methods for providing local level information about forests for specific market requirements. It is also designed to provide growers with a framework with

which to strategically market their produce for specific markets. It will address the critical issue of economies of scale among small forest owners. A cluster-based approach will be developed so that the management, thinning, harvesting and marketing requirements of farm forests can be achieved for a particular district area. The possibilities of this research include that prospective farm forests could market and sell their produce from the same area, increasing the area to be harvested, with much large volumes of material than individual sales.

Cost of Harvesting

The key issues for private growers in relation to the cost of harvesting are:

- evaluation of lower cost harvesting technologies
- scheduling of harvesting to coincide with adjacent harvesting in similar locations, and
- the adoption of agricultural style contractors to carry out harvest operations

One of the main obstacles to harvesting farm timber plantations is the cost of harvesting. Many forestry operations in Ireland are based on mechanical felling, processing and extraction to roadside by specialised forestry machinery. The cost of the first thinning of these plantations can be as high as €21 to €23/m³, which may be prohibitive for some farmers. This may be compounded by the fact that the total volume may be too low to generate interest in purchase of the material. The evaluation of alternative lower-cost methods for harvesting using tractor-based machinery suitable for small harvesting operations needs to be undertaken through a full financial analysis for different types of machinery.

Research to be conducted in 2007 in Teagasc and outlined above is designed to alleviate lack of scale in forest management and to address the cost of harvesting by providing a platform for the grouping of forest operations together in a forest cluster. It will result in lower harvesting costs and would provide opportunities for new and existing forestry contractors and offers larger job lots than individual jobs. The work could be supplemented by scheduling harvest operations to coincide at adjacent locations so as to maximise efficiency and productivity of operations.

The adoption of agricultural style contractors to carry out harvest operations would be of great benefit to farmers, who are familiar in dealing with contractors for many farm operations and are comfortable with this procedure.

Location of Forests in Relation to Potential Markets

One of the main obstacles to harvesting is the location of the farm forests relative to potential markets, especially in the case for thinning. There are five major board mills and 80 sawmills in Ireland (Fig. 2). These vary in size from large sawmills with kiln drying facilities processing hundreds of thousands of tonnes to small sawmills processing thousands of tonnes. Of a total roundwood output of 3.4 M m³ produced in Ireland in 2005, 73% (2.4 M m³) was sold to the sawmill sector, and the remaining to the pulp and stake sector. Five main sawmills processed 70% of the sawlog with 10 sawmills processing 90% of the roundwood produced (Coillte 2005). The remaining 70 or so smaller sawmills only processed

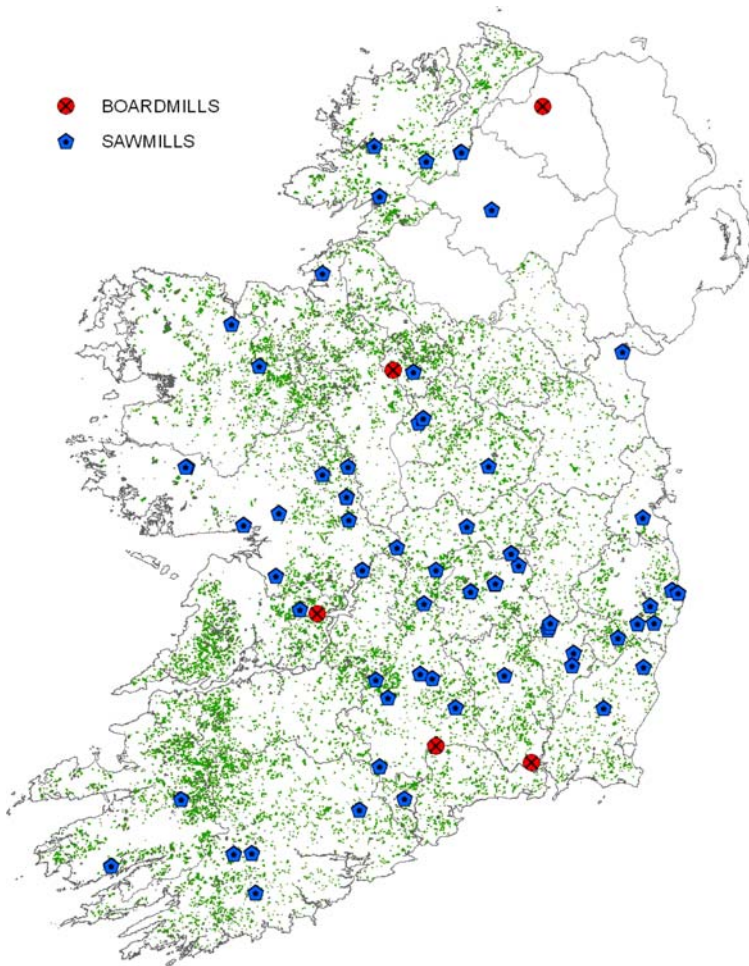


Fig. 2 Location of board mills (dots) and sawmills (pentagons) in Ireland in relation to the distribution of private forests (shaded area in background)

10% of the sawlogs. It is clear that small sawmills play a vital part in the development of the local farm forest resource and that the expansion of these sawmills will be needed to handle the extra anticipated output in roundwood production from farm forests. An analysis using GIS techniques conducted by the author revealed that 82% of private forests were within 20 miles (32 km) of a sawmill (Fig. 3). This network of smaller sawmills throughout the country is favourable for private growers. Smaller sawmills would be more likely to accept small timber volumes where the resource is located close to their doorstep. Efforts are needed to help smaller sawmills expand and to gear up to mill farm-grown logs. Such a development would be of great benefit to the private growers in Ireland.

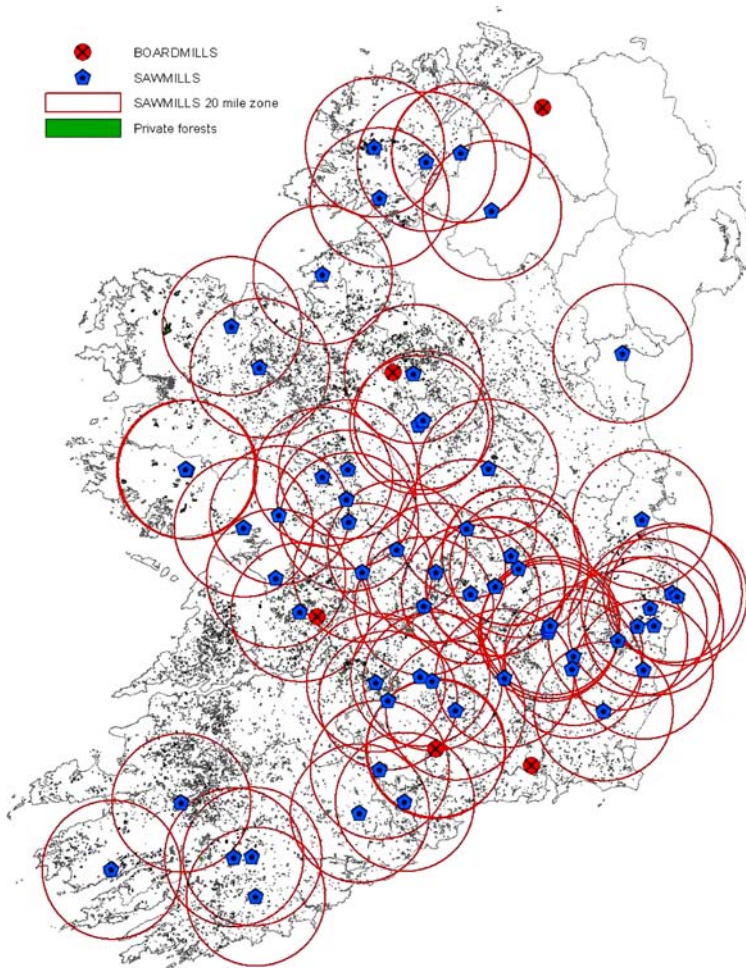


Fig. 3 Spatial distribution of sawmills and boardmills in relation to private forests in Ireland, using a 20-mile radius

Inadequate Roding Access to Plantations

The key issues for private growers in relation to road access are:

- the need for increased grants for forest roding
- arrangements put in place with local authorities regarding access to public roads
- consideration of alternative harvesting technologies, involving small-scale extraction machinery, and
- consideration of a 'no thinning' policy in areas with difficult road access.

Many plantations on farms have access problems in relation to the public road network. Traditionally, forests were planted on farms on land 'at the back of the farm'. As a result, roding structures are poor, and it is crucial that additional within-farm roads are constructed before harvesting operations take place. The Forest

Service provides roading grants to plantation owners prior to the commencement of harvesting operations and a recent COFORD publication on forest roads (Ryan et al. 2004) has greatly added to the technical knowledge about the design, construction and management of forest roads for small plantation owners. However, there may be plantations which are not adequately covered by the roading grants, in terms of roading density or for which issues with local authorities exist about access to public roads, and these problems need to be addressed before harvesting can commence.

It may also be appropriate to consider alternative harvesting technologies, involving small-scale extraction machinery more appropriate to first thinning operations to help reduce costs, or to evaluate additional methods of timber extraction such as skyline in areas with difficult terrain and low-pressure ground-bearing machinery or smaller machines where ground conditions are such that it is difficult to minimise site disturbance. Where access is very difficult (on wet or steep terrain) it may be more suitable to adopt a no-thinning policy.

Plantation Stability and Wind Damage

The key issues for private growers and tree stability are:

- assessment of windthrow risk of plantations
- no thinning may be a safer policy where windthrow risk is high, and
- loss in revenue from plantation damage.

The single greatest threat to forests in Ireland is damage caused by wind. The site factors which influence wind damage are soil type, height of the trees, altitude and location. Ni Dubhain et al. (2001) developed a model of windthrow risk for Ireland, which predicts the likelihood of a stand suffering windthrow based on soil type, altitude, height of the trees and windiness. This model was applied to an example of plantations with a tree height of 20 m. and with an altitude of 100 m in windzones C or D⁵

for well-drained and poorly drained soils. Two scenarios were chosen, namely a no-thinning and thinning policy. Predicted windthrow probabilities are reported in Table 3. It is clear from this analysis that thinning greatly increases the risk of windthrow, the probability being as high as 80% on poorly drained soils but lower at 33% on well-drained soils. Well-drained soils include Brown Earths, Brown Podzolics and Grey Brown Podzolic soils, while poorly drained soils are Gleys and Peat

Table 3 The probability of windthrow in relation to soil types, based on top height of 20 m and on a no-thin or a thinning policy

Soil type	Windthrow probability, no thinning (%)	Windthrow probability, thinning (%)
Well-drained soils	11	33
Poorly-drained soils	50	80

⁵ Ireland is divided into five windzones (A to E), A being areas with the highest winds such as south-westerly coastal locations, and gradually declining in windiness to windzone E in the central mid-lands where windspeeds are at their lowest. Windzones C or D have average to above-average windiness.

soils. For soils with a high probability of windthrow, it may be more appropriate to adopt a no thinning policy to reduce the risk of windthrow. In the case of the poorly-drained soils, the risk of windthrow is decreased from 80% to 50% by adopting a no-thin policy.

Scenario modelling suggests that a high proportion of private stands have a high probability of windthrow if thinned, and that this risk can be substantially reduced if the stand is left unthinned. Stands on better-drained soils have a one in three chance of windthrow if thinned, and this can be reduced to a one in 10 chance if left unthinned.

It is important to consider the potential loss in revenue associated with wind damaged stands (€20 per m³ for lower value product combined with higher harvesting costs). If considering thinning of plantations where there may be high windthrow risk, costs are minimized by thinning early or thinning conservatively.

Timing of Operations and Financial Consequences

Two scenarios have been formulated and analysed in order to compare the profitability of a farm forestry enterprise based on thinning and not thinning. The example is based on real data taken from a farm forest site in Ballygar, Co. Galway. The plantation, of 7.8 ha of Sitka spruce (*Picea sitchensis* (Bong.) Carr.) has the following crop details:

- Age 18
- Yield class 24+ m³/ha/annum
- mean dbh of 17.8 cm
- Stocking rate of 2188 stems/ha
- Mean top height of 15 m
- Mean basal area 0.025 m²
- Basal area of 54.5 m²/ha
- Standing volume of 344 m³/ha
- Productive area of stand is 85%

Profitability Under No-thinning Scenario

For the no-thinning scenario the volume assortments and the total value of the crop have been based on modelling of growth output of the stand using the Irish Dynamic Yield Models (COFORD 2005), and are reported for various ages in Table 4. The maximum net present value (NPV) of the crop is at age 35 (Fig. 4). For this crop a maximum NPV of €12,983/ha can be expected at age 35 with no thinning. A comparison of volume assortments at different ages is provided in Fig. 5.

Profitability Under Thinning Scenario

For the thinning scenario the crop received a first thinning at age 17 to remove a basal area of 18 m²/ha, then three subsequent thinnings to remove a volume of 80 m³/ha in 3 cycles at 5-year intervals. The total thinning yield was 346 m³/ha. This is based on thinning to Marginal Thinning Intensity at 5-year cycles (as recommended by Edwards and Christie 1981). A financial analysis for age 35 indicates that

Table 4 Volume assortments, total volume, total value, total net present value, and net present value per hectare for an unthinned plantation at various ages in Co. Galway

Stand age (years)	Volume assortment			Total volume (m ³)	Total value (€)	NPV (€)	NPV (€/ha)
	7–13 cm	14–20 cm	>20 cm				
27	94.52	220.58	399	714	132,650	81,436	10,440
30	94.52	220.58	399	714	177,392	94,075	12,061
32	78.87	188.73	602	870	200,279	96,338	12,351
34	72.59	172.74	679	924	231,852	101,156	12,969
35	69.4	164.36	715	949	243,717	101,269	12,983
36	66.28	155.82	751	973	249,683	98,808	12,668
37	63.11	147.16	716	926	259,497	97,802	12,539
40	53.65	121.02	881	1056	270,206	87,971	11,278

the value of the crop is €232,237 compared to the value of €243,717 for the unthinned crop. However, the net present value of the thinned crop is €109,538 compared with a value of €101,269 for the unthinned crop. Thinning increases NPV by €8,269, because of the earlier revenue from thinnings (Table 5).

Lack of Forestry Knowledge among Farmers and Willingness and Ability to Conduct Silvicultural Operations

The key issues for private growers and silvicultural knowledge are:

- farmers are made aware that plantations may need to be thinned
- a publicity campaign is conducted to support management of private forests
- a culture of good forest practice is encouraged
- farmers are educated about basic principles of plantation management.

One of the main problems associated with farm forestry in Ireland is the lack of knowledge among farmers about forestry and forestry operations. Farmers are sometimes unaware that their plantations need to be thinned and if they do know then they are unaware of how much volume to remove or who will carry out the

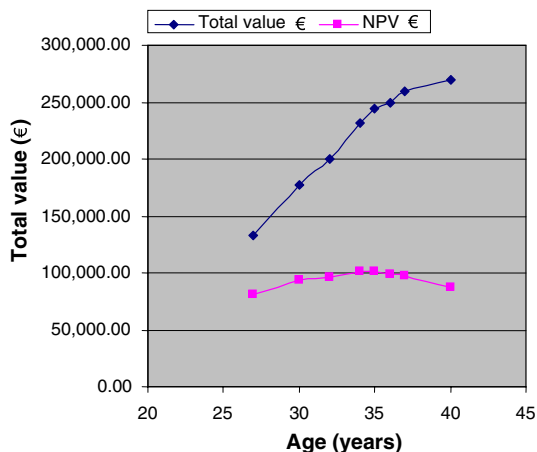
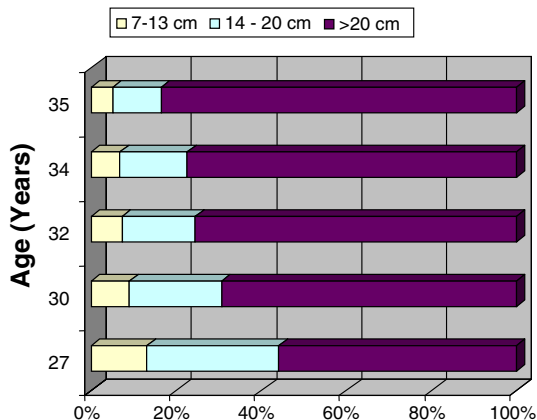
Fig. 4 Total value and net present value of a farm forest plantation in Ballygar, Co. Galway, no-thin policy

Fig. 5 Volume assortment per category by age based on a no-thin policy on a farm forest site in Ballygar, Co. Galway



operation. In recent years, Teagasc—the Agricultural and Food Development Authority—has initiated a series of demonstration days and briefing sessions with farmers. The purpose of the information sessions is to transfer knowledge about forestry from professional foresters to farmers in a readily understood and non-technical manner. A number of demonstration and monitor forests located on farms have been established by Teagasc and are used to teach and train farmers the basic principles of forestry. It is important that this role is expanded and that is aided by new research so that all farmers are made aware of the options for management for their farm forest into the future. In many cases, farmers may be unwilling or not be able to conduct harvesting operations themselves. This is partly due to lack of time availability, reluctance to incur additional costs of purchasing machinery and physical nature of the work. The average age of farmers in Ireland is 54 years (Connolly et al. 2006). For these situations the only answer is to educate farmers about the benefits of management of their plantations, so that they have adequate information when deciding what course of action to take.

Promotion of Good Thinning and Harvesting Practice

The key issues for private growers and good thinning and harvesting practice to ensure peace of mind for farmers are:

- farmers are made aware of the consequences of over-thinning

Table 5 Volume assortments, total volume, total value, and total net present value, net present value per hectare for a thinned plantation at ages 35 in Co. Galway, plantation age 35

Assortment	Timber volume (m ³)	Share of volume (%)	Total value (€)	NPV (€)
7–13 cm	11	2%		
14–20 cm	42	6%		
>20 cm	632	92%		
Total volume at clearfell	685	100%		
Total volume including thinnings	1031			
Total value			232,237	109,538

- adequate thinning control is performed
- contractors are adequately trained in the practice of thinning.

An issue that is of concern for private forest growers is that adequate care is taken when their plantations are being thinned. It is crucial that plantations are not over-thinned because this can lead to loss of revenue due to reduced volume in final crop. Further, thinning also opens up the forest canopy to the potential of windthrow. If windthrow takes place in a relatively young stand then the anticipated return on investment may not be realised. A particular need for further education for farmers and forest contractors regarding the promotion of good thinning and harvesting practice with particular reference to benefits' of thinning, thinning control and selection of trees for thinning needs to be addressed.

Conclusion

Much progress has been made in Ireland regarding the promotion of the afforestation of—mostly agricultural—land, with an average annual planting rate over the 16 years since 1990 of 12,000 ha. A high proportion of private forestry and farm forestry (41,000 ha) is now at or past first thinning age. Over the coming years the massive bulk of farm forests planted during the peak afforestation periods of the 1990 s will reach first thinning age. The potential of this resource to rural Ireland is enormous. Scenario modelling suggests that if even 50% of all private forest plantations were managed and thinned, then an estimated 5 M m³ of timber could be harvested from these forests by 2015. The value to the rural economy is great with farm forestry having the potential to contribute €56 M over the period directly into grower's pockets.

As the focus of government forest policy in Ireland has been primarily aimed at the afforestation programme in recent years, forests established under the various grant aided schemes are fast approaching a time where adequate planning, for their management is addressed. It is clear that research will play a key role in the development of methods to aid the management of the plantation resource. This paper highlights a number of issues that need to be addressed in order that growers have the chance to achieve potential financial returns. It is clear that new markets need to be created and that existing markets may need to be expanded. This includes the sawmilling and board milling sectors. In order for companies to increase capacity, they need to be reassured that the potential output from farm forests is realisable. This could be achieved by local-level forest management planning using inventories of farm plantations to generate forecasts of production. These management plans can then be used to group farm plantations together to achieve economies of scale in order to market and sell timber. Such plans would also be useful for the scheduling of forest operations by moving forward or backward forest thinning operations to synchronise them with other local operations that are taking place.

Wood energy market potentially offers alternative market opportunities for farm forest produce, especially with the difficulty in selling the low value products including pulp. It is clear that recent government incentives in Ireland providing grants of 30% for the capital costs of wood boilers for private householders and businesses has lead to an increased interest in wood energy. More work on

marketing wood energy products (such as wood chip) from farm forests together with research on the optimal rotation period for wood energy crops and the costs of harvesting and revenue associated with these enterprises need to be initiated. Information needs to be more readily available to farmers to enable them make a more informed decision about choice of produce type from the farm forest. Other issues such as location of plantations, access and the cost of harvesting operations are the subject of current research by Teagasc in Athenry.

The main issue forest growers have in relation to their individual plantations is the problem of windthrow. It is clear that plantations on poorly drained soils have a high windthrow risk. In many cases it may be decided that plantations will remain unthinned where the risk of windthrow is great. Further research needs to be conducted to understand the effects of thinning early or respacing on crop development and stability, in order to formulate sound recommendations regarding thinning practice. Not thinning leads to a potential loss in revenue due to the longer wait for payment for the produce. Yield modelling and financial analysis suggests a higher NPV associated with thinned plantations compared to unthinned stands. This however may not be the principal consideration in the choice of thinning regime because the potential for windthrow may offset any perceived benefits associated with thinning. It is also clear that farmers need additional information in order to understand about the management of their forests. This is currently being addressed by Teagasc in its research program. In addition, a protocol for thinning control would be welcomed in order to protect grower's interests.

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